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Nanotech News

[Back](#)**March 2009**

Safer Nanoparticles Spotlight Tumors, Deliver Drugs

Small is promising when it comes to illuminating tiny tumors or precisely delivering drugs, but many worry about the safety of nanoscale materials. Now a team of scientists has created miniscule flakes of silicon that glow brightly, last long enough to slowly release cancer drugs, then break down into harmless byproducts. "It is the first luminescent nanoparticle that was purposely designed to minimize toxic side effects," said Michael Sailor, Ph.D., University of California, San Diego. Dr. Sailor, along with coprincipal investigators Sangeeta Bhatia, Ph.D., Massachusetts Institute of Technology, and Erkki Ruoslahti, M.D., Ph.D., are members of the [National Cancer Institute's Alliance for Nanotechnology in Cancer](#).

Many nanoparticles tested in research labs have potential toxicities that make them unsuitable for use in humans. "This new design meets a growing need for nontoxic alternatives that have a chance to make it into the clinic to treat human patients," Dr. Sailor said. The properties of these new nanoparticles are reported in a paper published in the journal *Nature Materials*.

The particles inherently glow, a useful property that is most commonly achieved by including toxic organic chemicals or tiny structures called quantum dots, which can leave potentially harmful heavy metals in their wake. When the researchers tested their safer nanoparticles in mice, they saw tumors glow for several hours, then dim as the particles broke down. Levels dropped noticeably in a week and were undetectable after 4 weeks. This is the first study to image tumors and organs using biodegradable silicon nanoparticles in live animals, the authors say.

The particles begin as thin wafers made porous with an electrical current then smashed to bits with ultrasound. Additional treatment alters the physical structure of the flakes to make them glow red when illuminated with ultraviolet light. Luminescent particles have the potential to reveal tumors too tiny to detect by other means or allow a surgeon to be sure all of a cancerous growth has been removed.

These nanoparticles also could help deliver drugs safely, the researchers report. The cancer drug doxorubicin will stick to the pores and slowly escape as the silicon dissolves. "The goal is to use the nanoparticles to chaperone the drug directly to the tumor, to release it into the tumor rather than other parts of the body," Dr. Sailor said.

Targeted delivery would allow doctors to use smaller doses of the drug. At doses high enough to be effective, when delivered to the whole body, doxorubicin often has toxic side effects.

At about 100 nanometers, these particles are bigger than many designed to deliver drugs, which can be just a few nanometers across. Their larger size contributes to both their

effectiveness and their safety. Large particles can hold more of a drug, yet they self-destruct, and the remnants can be filtered away by the kidneys. Close examination of vulnerable organs like liver, spleen, and kidney, which help remove toxins, revealed no lasting changes in mice treated with the new nanoparticles.

This work, which was detailed in the paper “Biodegradable luminescent porous silicon nanoparticles for in vivo applications,” was supported by the [NCI Alliance for Nanotechnology in Cancer](#), a comprehensive initiative designed to accelerate the application of nanotechnology to the prevention, diagnosis, and treatment of cancer. An abstract is available at the journal’s Web site.

[View abstract](#)